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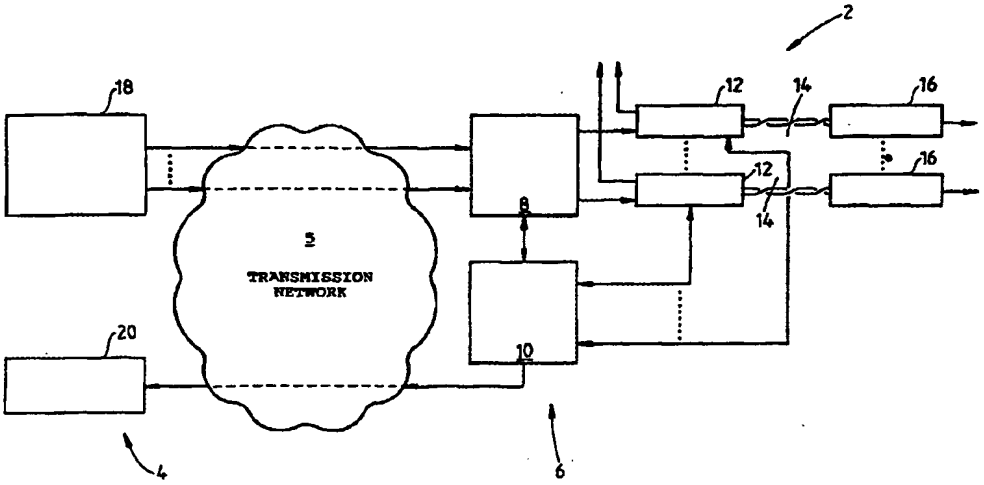

(57) Abstract

A video signal distribution system (2) including video signal provider equipment (4) for providing video signals to at least one local exchange (6) of a telecommunications network. The local exchange (6) includes a multicast video switch (8) for receiving the video signals and a plurality of ADSL exchange units (12) for transmitting video signals to a plurality of respective ADSL customer units (16). The video switch (8) multicasts the video signals to the exchange units (12) for transmission to the customer units (16). The video signals provided to an exchange unit (12) can be selected by the video switch (8) on the basis of control data received from the customer unit (16) by the exchange units (12).

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A VIDEO SIGNAL DISTRIBUTION SYSTEM

The present invention relates to a video signal distribution system and, in particular, to a system which enables video signals to be distributed over a public switched telephone network (PSTN).

Different techniques and technologies have been proposed for providing a variety of video and television services to the home, in addition to the existing free to air broadcast network. The services include:

1. Video on demand (VOD) where movies and video programs are transmitted to a customer on request. The video signals may be transmitted immediately or at a time selected by the customer. Depending on the video signals transmitted, a communication channel between the video signal provider and the customer may also be used to allow the customer to send control signals to the provider to control transmission functions, such as pause, fast forward and rewind, or in the case of interactive video game, signals which dictate play of a game. This communication channel may also be used to provide interactive capability to other types of services, e.g. educational, home shopping, etc.
2. Pay per view (PPV) where video programs are scheduled for transmission and a customer is only charged for the programs selected to view.
3. Pay TV where a customer is able to access broadcast scheduled video programs and pays a subscription charge for Pay TV channels.

Telecommunications networks can be used to distribute video services. A transmission technology known as asymmetric digital subscriber line (ADSL) technology has been developed to allow the transmission of high bit rate video signals on the existing copper wires of a PSTN. An ADSL line is asymmetric because it allows the transmission of up to 8 to 25 Mb/s or more to customers from a local exchange but only allows low speed (e.g. 16 kbs, 64 kbps or 640 kbps) control signals to be sent to and from the customer and the local exchange. A line carrying ADSL signals also allows simultaneous transmission of plain old telephone system (POTS) services between a customer's telephone and the exchange. Two modulation techniques available for signal transmission on an access line are known as discrete multi-tone (DMT) and carrierless amplitude phase (CAP) modulation. ADSL technology is described in a number of publications, such as:

1. ANSI Standard T1E1.4/94-007 Network and Customer Installation Interfaces. Asymmetric Digital Subscriber Line (ADSL) Metallic Interface.
2. J.J. Werner, Tutorial on Carrierless AM/PM - Part I - Fundamentals and Digital CAP Transmitter UDF Document, 29 September, 1991. Also: Contribution to ANSI X3T9.5 TP/PMD Working Group, Minneapolis, 23 June, 1992.
3. M. Sorbara, J.J. Werner and N.A. Zervos, "Carrierless AM/PM", Contribution T1E1.4/90-154, 24 September, 1990.
4. W.Y. Chen, G.H. Im and S.S. Werper, "Design of Digital Carrierless AM/PM Transceivers", Contribution T1E1.4/92-149, 19 August, 1992.

Whilst ADSL technology has been suggested as a suitable platform for providing video on demand services, an efficient system architecture is required to distribute video signals.

In accordance with the present invention there is provided a video signal distribution system, including:

video signal provider equipment having first telecommunications means for providing video signals to at least one local exchange of a telecommunications network; and

local exchange equipment having second telecommunications means for receiving said video signals, a plurality of exchange units for transmitting video signals to a plurality of

respective customer units, and a multicast video switch for multicasting said video signals received by said second telecommunications means to said plurality of exchange units for transmission to said customer units.

The present invention also provides a video services distribution system including:

a video switch for receiving a plurality of video service channels from a telecommunications network, said video switch having a selection unit for multicasting said service channels to customer video channels; and

modulating units for modulating signals on said customer video channels, received from said video switch, for transmission on telecommunication lines to respective customer units.

Preferred embodiments of the present invention are hereinafter described, by way of example only, with reference to the accompanying drawings, wherein:

Figure 1 is a block diagram of a preferred embodiment of a video signal distribution system;

Figure 2 is a block diagram of a local exchange of the system connected to customer premises equipment;

Figure 3 is a block diagram of a first preferred embodiment of the local exchange;

Figure 4 is a second preferred embodiment of the local exchange;

Figure 5 is a block diagram of the local exchange of the first embodiment using 155 Mbit/s service distribution;

Figure 6 is a block diagram of a network element of the local exchange of Figure 5;

Figure 7 is a block diagram of the local exchange of the first embodiment using 622 Mbit/s service distribution;

Figure 8 is a block diagram of a network element of the local exchange of Figure 7;

Figure 9 is a diagram illustrating cross-connection of channels of the local exchange of Figure 7;

Figure 10 is a schematic diagram of a local exchange of the second embodiment;

Figure 11 is a block diagram of a local exchange of the second embodiment using a 622 Mbit/s local exchange ring; and

Figure 12 is a block diagram of a local exchange of Figure 11 with a dual head local

exchange ring.

A video distribution system 2, as shown in Figure 1, includes video signal provider equipment 4 which is able to provide video and/or interactive services to customers over a transmission network 5, such as the PSTN, to a local exchange 6 associated with the customers. The local exchanges 6 of the distribution system 2 each include a video switch 8 and a video switch controller 10 which both connect to ADSL exchange units (EUs) 12 of the exchange 6. The ADSL exchange units 12 can be connected via copper pairs 14 to respective ADSL customer units 16. The video signal provider equipment 4 includes a video head-end 18 and a billing and operation, administration and management (OAM) system 20. The video head-end 18 stores video signals for up to N different channels, which may be VOD, Pay TV or PPV channels, and downloads video signals on the channels to the video switch 8 of each exchange 6, via the transmission network 5. The video switch 8 selectively switches the n channels to the m ADSL exchange units 12 of the exchange 6 in response to control signals from the video switch controller 10. The video switch controller 10 selects a channel for each ADSL exchange unit 12 in response to control signalling data received from the EUs 12, which is sent by the ADSL customer units 16, or from the provider equipment 4. Channel switching for video channels which carry continuous video data, such as Pay TV, PPV and free to air channels, are switched locally at the exchange 6 by the video switch 8 and the controller 10. The video switch 8 is able to multicast each one of the input channels received from the head-end 18 to selected ADSL exchange units 12 for selected customers, removing the necessity for each customer to have a respective high capacity video signal downstream channel back to the provider equipment 4. The ADSL units 12 and 16 are able to transmit POTS and ISDN signals with the video signal sent downstream to the customers and the control and signalling data sent in both directions between the exchange 6 and the customer. The billing and OAM unit 20 receives billing and operation, administration and management (OAM) data from the video switch controller 10 via the transmission network 5. The controller 10 may simply pass data provided to it by the ADSL exchange units 12.

The video signals output by the video head-end 18 may be obtained from a storage system such as a video server architecture or digital video tape. The video signals may also be

provided from a real-time source, such as an MPEG encoder. The video signals of the channels are encoded at 2 or 6 Mbit/s for example. The telecommunications infrastructure used to distribute the video signals from the provider equipment 4 to all of the local exchanges 6 of the video delivery network of the system 2 needs to be able to handle high-bandwidth, semi-permanent, unidirectional video connections between providers 4 and each exchange 6. The synchronous digital hierarchy (SDH) transmission system and protocol, as specified by the International Telecommunications Union (ITU), is able to achieve this, and two transmission standards of SDH can be used on the network 5, being STM-1 (155 Mbit/s) and STM-4 (622 Mbit/s). STM-4 is best used for transmission between the video storage system and hubs and regional hubs of the provider equipment 4. Regional hubs can then be connected to the local exchanges 6 using STM-1 links. Channels broadcast to the video switches 8 can be transmitted in a distribution ring to allow multiple splitting of video data at each regional hub with a connection to a local exchange 6. Transmission of the billing and OAM data would also use an SDH transmission network 5. The video switch 8 and the video switch controller 10 maintain effective and reliable switching to ensure all video and interactive services which can be provided by the equipment 4 is distributed to customers over the ADSL links 14. The switch 8 and controller 10 provide the following:

(a) Transparent switching of digitally coded video signals and other information services.

(b) Multicast switching to the m customers of the exchange 6, which includes point-to-multipoint switching for Pay TV, PPV, near-VOD, free to air services, and point-to-point switching for VOD and interactive services.

(c) Non-blocking switch operation.

(d) Modular expansion.

(e) Locally controlled switching, as described above, to facilitate rapid response times when changing channels.

The video switch 8 and controller 10 can be implemented using SDH cross-connect units. Preferred alternatives for implementing the switch 8 and controller 10 include:

(a) An SDH ADM Ring - SDH network elements (NE) are interconnected at the local exchange 6 to form a ring so they behave as a distributed cross-

connect switch. The SDH ring is described in detail below.

(b) An SDH 4/1 DXC - For larger sites, an NEC SXS-W 4/1 digital cross-connect (DXC) switch can be used to support the video multicasting and other digital switching requirements of a local exchange 6.

(c) An ATM Multicast Switch - An asynchronous transfer mode (ATM) switch which supports both multicast and point-to-point connections.

(d) An NEC Video Distribution Switch - The NEC video distribution switch described in the specification of NEC Australia Pty. Ltd.'s co-pending International patent application.

The output cross-connect channels are fed into the m ADSL exchange units 12, as shown in Figure 2, which include ADSL modems. The switch 8 and controller 10 are provided by one of the cross-connect switching options described above, which receives n channels from the transmission network 5 using an SDH NE 22 and all control data, such as billing and OAM data, is passed between the SDH NE 22 and the ADSL exchange units 12 on a control channel 24. Local switching is performed by the cross-connect unit 23 in response to signals on a switch control channel 26 which is supported by a switching controller, such as the CPU, of the ADSL exchange units 12.

At the customer premises, the ADSL customer unit 16 is able to receive and demodulate the downstream high speed digital video signals, together with any signals received on the low speed control channel. The customer unit 16 is also able to modulate and transmit on the control channel customer connection requests and status information in the upstream direction to the exchange 6. The customer unit 6 includes POTS splitters for transparently combining and extracting telephone signals on the line 14 for the customer's telephone 28. The customer unit 16 includes an ADSL modem and is preferably as described in the specification of NEC Australia Pty. Ltd.'s co-pending International patent application. The ADSL customer unit 16 connects to the customer set-top unit (STU) 30. The STU 30 connects to a customer's television and allows customers access to the Pay TV, VOD, PPV, and other services which are provided on the ADSL line 14. The STU 30 decodes MPEG video and audio for playing on connected TV and/or video and hi-fi equipment. The STU 30 can, if desired, be integrated with the ADSL customer

unit 16.

To implement the SDH ADM ring, the SDH inter-exchange network (IEN) 5 can be extended into the local exchange 6. SDH based switching can be implemented using add-drop multiplexers (ADMs) or 4/1 DXC equipment. In addition, the switching can be performed by either connecting equipment directly as part of the IEN 5 or externally linking the equipment to the IEN 5. The two alternatives are illustrated in Figures 3 and 4. For the first configuration of Figure 3, the ADSL equipment 12 is connected directly to network elements 32 of the IEN 5 which support and combine service distribution and customer switching requirements on the channels 24 and 26. The configuration is a cost effective solution for small installations or trial systems. The configuration illustrated in Figure 4 uses an SDH ring 34 of SDH network elements 36 at the local exchange 6 for switching of channels using the switch control channel 26. The SDH ring 34 is connected to an SDH network element 38 which forms part of the SDH IEN 5. The SDH NE 38 supports the control channel 24. The configuration of Figure 4 separates the subnetworks used for services distribution and for customer channel switching. The configuration is also more easily upgradable. Both configurations employ the NEC IS-3000 ADSL exchange units 12 described in the specification of NEC Australia Pty. Ltd.'s co-pending International patent application. The ADSL exchange units 12 provide interfaces between the ITU G.703 standard output interfaces of the SDH equipment 36 and 38 and the ADSL lines 14. The exchange units 12 also support the 2 Mbit/s control channel 24 for communication between the head network element 38 and the exchange units 12, and in turn the ADSL customer unit 16 and STUs 30. The exchange units 12 also provide support for one or more ADM switch control lines 26 for the SDH NEs.

The control channel 24 is a bidirectional 2 Mbit/s signal which uses HDLC framed messages. The messages provide communications links between:

(i) The exchange units 12 and the management system 20.

(ii) The ADSL customer unit 16 and the management system 20.

(iii) The STUs 30 and the management system 20.

(iv) The STUs 30 and the service provider equipment 4.

Additional control channels 24 can be used as customer application bandwidth requirements increase. The control channels 24 are terminated in the regional NE 38 of the IEN 5 where messages are then routed to the appropriate management system or provider equipment 4. For the channel change request received from the customers by the exchange units 12, the exchange units 12 separate the requests from the upstream control channel 24 if the requests are for a channel already received by the local exchange 6. The requests are formatted into suitable commands for the SDH NEs 36 and placed on the switch channel 26.

The following add-drop multiplexers can be used for customer channel switching, each of which are commercially available units:

SMS-150A: STM-1 (155 Mbit/s) ADM with a maximum of 63 × 2 Mbit/s tributary interfaces.

SMS-600W: STM-4 (622 Mbit/s) wideband ADM with a maximum of 126 × 2 Mbit/s tributary interfaces. An additional 126 × 2 Mbit/s tributaries can be added by using a SMS-150T2 expansion subrack.

SMS-2500A: STM-16 (2500 Mbit/s) ADM with a maximum of 16 × STM-1 (or 4 × STM-4) tributary interfaces. Additional SMS-600W or SMS-150As may be used to access 2 Mbit/s tributaries.

SMS-2500W: STM-16 (2500 Mbit/s) wideband ADM with a maximum of 252 × 2 Mbit/s tributaries. Additional SMS-600Ws may be used to access extra 2 Mbit/s tributaries.

The following configuration examples are described hereinafter:

(i) STM-1 service distribution, IEN based customer channel switching;

(ii) STM-4 service distribution, IEN based customer channel switching; and

(iii) STM-4 service distribution, local exchange ring based customer channel switching.

In the STM-1 IEN based customer channel switching configuration, NEC's SMS-150A unit 40 can be used for video signal distribution and switching. The configuration supports small to medium sized Pay TV and VOD networks with 63 × 2 Mbit/s per second customers being

supported for each SMS-150A 40. The SMS-150A units 40 are connected to form an STM-1 fibre ring in order to connect one or more local exchanges 6, as shown in Figure 5, to a regional hub site. The SMS units 40 receive video interactive services from the IEN 5 and support both the switch control channel 26 and the 2 Mbit/s control channel 24. Each unit 40 is connected to the ADSL exchange units 12 to support 63 × 2 Mbit/s downstream channels. Each fibre line of the STM-1 ring 42 supported by the SMS units 40 is a unidirectional self-healing ring with path protection (USHR-P), also referred to as a path protection switched (PPS) ring. This ensures customer traffic is maintained in the event of single or dual fibre cuts or in the case of total failure in a node of the ring. To increase the number of customers supported, additional SMS-150A units 40 can be added to the ring 42 without disrupting customer traffic.

The ADX unit 50 of the SMS-150A unit 40, as shown in Figure 6, provides a non-blocking cross-connect function at a 2 Mbit/s (VC-12) or 34/45 Mbit/s (VC-3) level. The ADX unit 50 permits point-to-point or point-to-multipoint switch connections to be established simultaneously, which may be unidirectional or bidirectional. Signals of different levels cannot be cross-connected, i.e. connection of a 2 Mbit/s steam to a 34 Mbit/s. The cross-connections performed by the ADX unit 50 include:

(i) Unidirectional connection from a line side channel received from the IEN ring 42 to one or more tributary channels sent on the 2 Mbit/s lines 44 connected to the ADSL exchange units 12.

(ii) Bidirectional cross-connection from a line channel to a tributary channel.

(iii) Bidirectional cross-connection between line side channels.

(iv) Unidirectional connection from an input tributary channel to one or more output tributary channels, for local insertion of content, if desired.

Configuration commands for the ADX unit 50 are generated internally by an ACM unit 52 of the SMS unit 40. The ACM unit 52 receives its commands from a local control (craft) terminal 53 (LCT) and/or a remotely located operations system (OS), such as the NEC networked craft terminal (NCT). The OS can be connected to the SMS unit 40 by a local LAN connection or remotely connected through the IEN 5 to a management centre. Connection through the IEN 5 is achieved using a communications channel in the framing overhead of the

STM-1 signal. OS communication uses a standard seven layer OSI protocol which is processed by the MCI unit 54 of the SMS unit 40. The OS can perform all administration, management and provisional control for each network element 40. This enables a single management system to be used for service distribution and local exchange customer switching in response to the signals on the control channel 24 and the switch control 26. The OS can form part of the OAM system 20 to also connect to the control channel 24. The SMS unit 40 supports simultaneous command entry from both the OS and LCT. This enables the use of the NEC IS-3000 exchange units 12 to provide LCT formats which control commands on the switch control channel 26 for input into the SMS unit 40. The LCT command format also allows for control of remote SMS units 40 attached through SDH bearers 42. The LCT interface 53 uses a binary message protocol which allows for fast input and processing of commands by the ACM unit 52, as compared to implementations which may use a more complex CMISE based interface. The message protocol used supports the performance required to respond to a large number of cross-connect change operations which may be issued in a video broadcast application. In simultaneously supporting point-to-point and multicast operations, the SMS unit 40 can be shared between video and other IEN traffic for efficient traffic distribution. The SMS unit 40 illustrated in Figure 6 includes an optionally redundant cross-connection matrix.

For STM-4 IEN based customer channel switching, NEC's SMS-600W units 60, as shown in Figure 7, are used for service distribution and switching and support of the switch channel 26 and the control channel 24. This configuration is suitable for medium to large sized video signal distribution networks. Each SMS-600W unit 60 can support 252 × 2 Mbit/s downstream channels 62 to the ADSL units 12. The SMS units 60 receive services from the IEN 5 and perform customer channel switching. An STM-4 fibre ring 66 is used to connect one or more local exchanges 6, and the ring 66 is supported by the SMS units 60. The ring 66 is a unidirectional self-healing ring with path protection (USHR-P). Additional SMS units 60 can be added to the ring 66 without disrupting customer traffic.

The ADX4W unit 68 of the SMS-600W unit 60, as shown in Figure 8, provides a non-blocking cross-connection function at 2, 34 or 140 Mbit/s levels. The unit 68 permits point-to-point or point-to-multipoint switch connections to be established simultaneously which may be

unidirectional or bidirectional. Only signals of the same level can be cross-connected. The cross-connections which can be performed by the ADX4W unit 68 are illustrated in Figure 9 and labelled A to D which represent the following:

A. Unidirectional connection from a line side channel on the ring 66 to one or more tributary channels on the downstream customer lines 62.

B. Unidirectional connection from a tributary input to one or more tributary outputs.

C. Bidirectional cross-connection between line channels.

D. Bidirectional cross-connection from a line channel to a tributary channel.

Configuration commands to the ADX4W unit 68 are issued internally by the ACM unit 70. The ACM unit 70 receives its commands from a locally attached control (craft) terminal (LCT) 53 and/or a remotely located operations system (OS) such as the NEC network craft terminal (NCT). The OS can be attached to the SMS-600W 60 by a local LAN connection or remotely connected through the IEN 5 to a management centre. A connection through the IEN 5 is achieved by using a communications channel in the framing overhead of the STM-4 signal. OS communication uses a standard seven layer OSI protocol which is processed by the SMS-600W MCI unit 72. The OS performs all administration, management and provisioning control for each NE 60. This provides the benefit of having a single management system for video distribution and local exchange video channel switching. The SMS-600W 60 also supports simultaneous command entry from both the OS and the LCT. This allows the NEC IS-3000 EUs 12 to input LCT format switch control commands into the SMS-600W 60. The LCT command format also allows for control of remote SMS-600W units 60 attached through SDH bearers 66. The LCT interface 53 uses a binary message protocol, which allows for the fast input and processing of commands by the ACM unit 70, as compared to implementations using a more complex CMISE based interface. The protocol supports the performance required to respond to the large number of cross-connect change operations issued in a video broadcast application. The SMS unit 60 simultaneously supports point-to-point and multicast operations, and as such, an SMS unit 60 can be shared between video and other IEN traffic thereby providing for efficient traffic distribution. The block diagram of Figure 8 includes optionally redundant components.

An STM-4 local exchange ring distribution switch configuration, as shown in Figure 10, is for use when a large number of local exchanges 6 are attached to a regional service distribution ring 74 and each exchange 6 is required to support a large number of customers. The architecture illustrated in Figure 10, and in Figure 4, separates the IEN transmission equipment from the customer channel switching equipment, which also has advantages for future capacity upgrades. The architecture can be applied to a distribution system which uses the SMS-150A units 40 or the SMS-600W units 60. Distribution using the SMS-600W units 60 is discussed hereinafter.

In the local exchange 6, a first SMS-600W unit 76 is used to collect services from the IEN ring 74, and drop four STM-1 signals to a second SMS-600W unit 78 if support for 252 services is required. If support of only up to 126 services is required, then two STM-1 signals can be passed to the second SMS-600W unit 78, as shown in Figure 11, and 126 × 2 Mbit/s customer channels can be dropped to the second unit 78. Third and fourth SMS-600W units 80 and 82 are used to form a three node self-healing ring 34 with the second SMS-600W unit 78. Each of the units 78 to 82 in the ring 34 can switch up to 252 × 2 Mbit/s customer channels, as previously described. For additional security against complete failure of the first or second units 76 and 78, the architecture can be modified to support a dual head-end linked ring 84, as shown in Figure 12 by adding a fourth SMS-600W unit 84 in the IEN ring 74, which can drop the 126 × 2 Mbit/s channels to the third SMS-600W unit 80 of the local exchange ring 84. A high level of unit protection by the SDH network elements may not be required in this instance which would result in substantial cost savings.

CLAIMS:

1. A video signal distribution system, including:

video signal provider equipment having first telecommunications means for providing video signals to at least one local exchange of a telecommunications network; and

local exchange equipment having second telecommunications means for receiving said video signals, a plurality of exchange units for transmitting video signals to a plurality of respective customer units, and a multicast video switch for multicasting said video signals received by said second telecommunications means to said plurality of exchange units for transmission to said customer units.

2. A video signal distribution system as claimed in claim 1, wherein said exchange units and said customer units are ADSL units.

3. A video signal distribution system as claimed in claim 2, wherein said video signals are Pay TV, PPV or free to air TV signals.

4. A video signal distribution system as claimed in claim 3, wherein said video signals are broadcast to said local exchange equipment.

5. A video signal distribution system as claimed in claim 2, wherein said video signals are VOD signals.

6. A video signal distribution system as claimed in claim 1, wherein said video switch outputs downstream video channels to said exchange units and supports a bidirectional data channel between said video switch, said exchange units and said customer units.

7. A video signal distribution system as claimed in claim 6, wherein said video switch executes switching of said video channels in response to switch control signals received on said bidirectional data channel from said customer units.

8. A video services distribution system including:

a video switch for receiving a plurality of video service channels from a telecommunications network, said video switch having a selection unit for multicasting said service channels to customer video channels; and

modulating units for modulating signals on said customer video channels, received from said video switch, for transmission on telecommunication lines to respective customer units.

9. A video services distribution system as claimed in claim 8, including a bidirectional data channel between said video switch and said modulating units for transmitting control data between said video switch and said customer units, said control data being modulated with the signals on said customer video channels by said modulating units and said customer units for transmission on said telecommunications lines.

10. A video services distribution system as claimed in claim 9, wherein said selection unit executes point-to-point or point-to-multipoint connections of said service channels to said customer video channels on the basis of channel select data received on said bidirectional data channel.

11. A video services distribution system as claimed in claim 10, wherein said video switch and modulating units are each included in a plurality of local telecommunications exchanges, and said video service channels are broadcast to said local exchanges.

12. A video services distribution system as claimed in claim 10 or 11, wherein said modulating units and customer units are ADSL units.

AMENDED CLAIMS

[received by the International Bureau on 19 February 1997 (19.02.97); original claim 1 amended; remaining claims unchanged (1 page)]

1. (Amended) A video signal distribution system, including:

video signal provider equipment having first telecommunications means for providing video signals, representative of a plurality of video service channels, to at least one local exchange of a telecommunications network; and

local exchange equipment having second telecommunications means for receiving said video signals, a distribution path for transmitting said video signals in said local exchange equipment, a plurality of exchange units for transmitting video signals to a plurality of respective customer units, and a multicast video switch for accessing selected video signals for selected video channels from said distribution path and multicasting said selected video signals to said plurality of exchange units for transmission to said customer units.

2. A video signal distribution system as claimed in claim 1, wherein said exchange units and said customer units are ADSL units.

3. A video signal distribution system as claimed in claim 2, wherein said video signals are Pay TV, PPV or free to air TV signals.

4. A video signal distribution system as claimed in claim 3, wherein said video signals are broadcast to said local exchange equipment.

5. A video signal distribution system as claimed in claim 2, wherein said video signals are VOD signals.

6. A video signal distribution system as claimed in claim 1, wherein said video switch outputs downstream video channels to said exchange units and supports a bidirectional data channel between said video switch, said exchange units and said customer units.

7. A video signal distribution system as claimed in claim 6, wherein said video switch executes switching of said video channels in response to switch control signals received on said bidirectional data channel from said customer units.

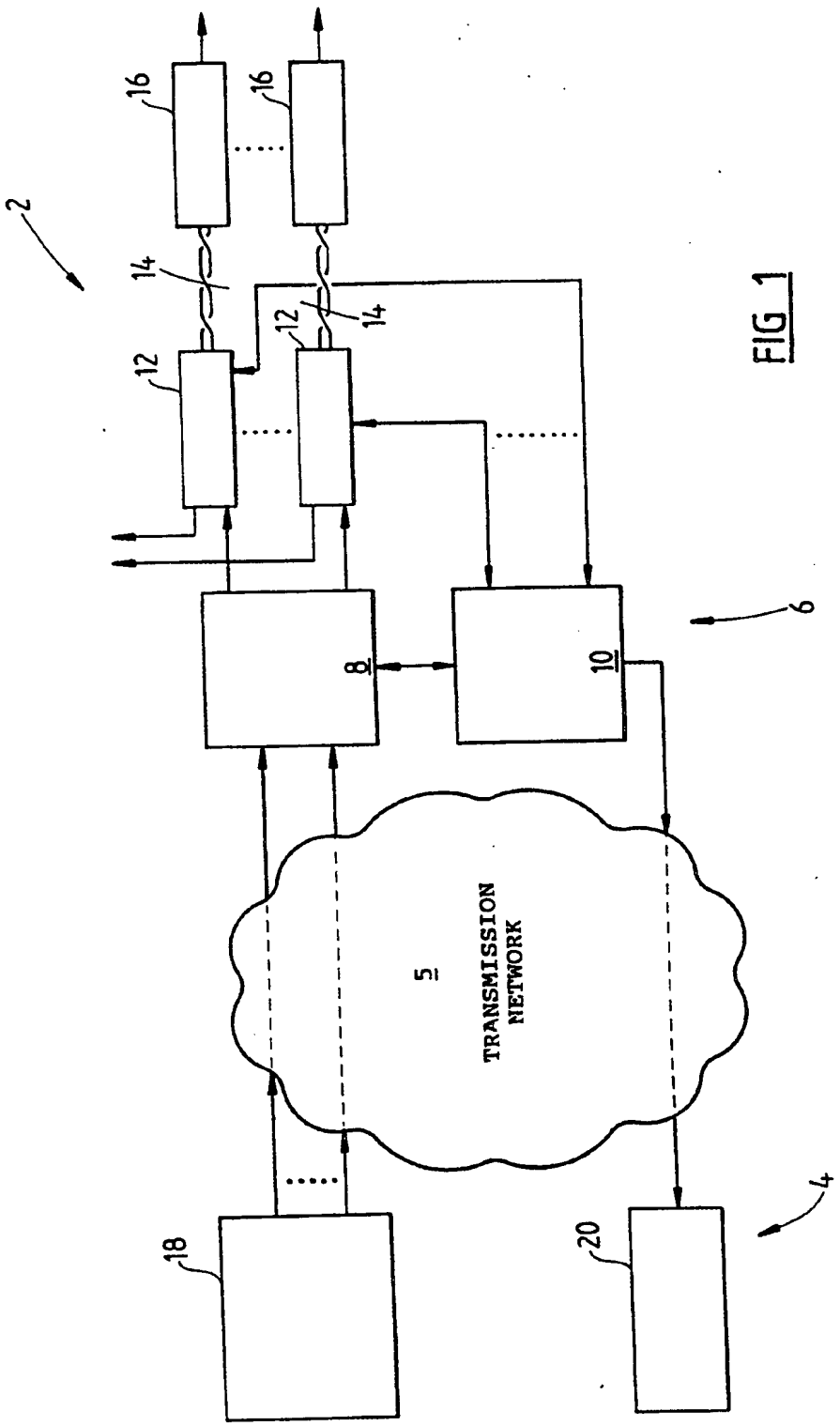


FIG 1

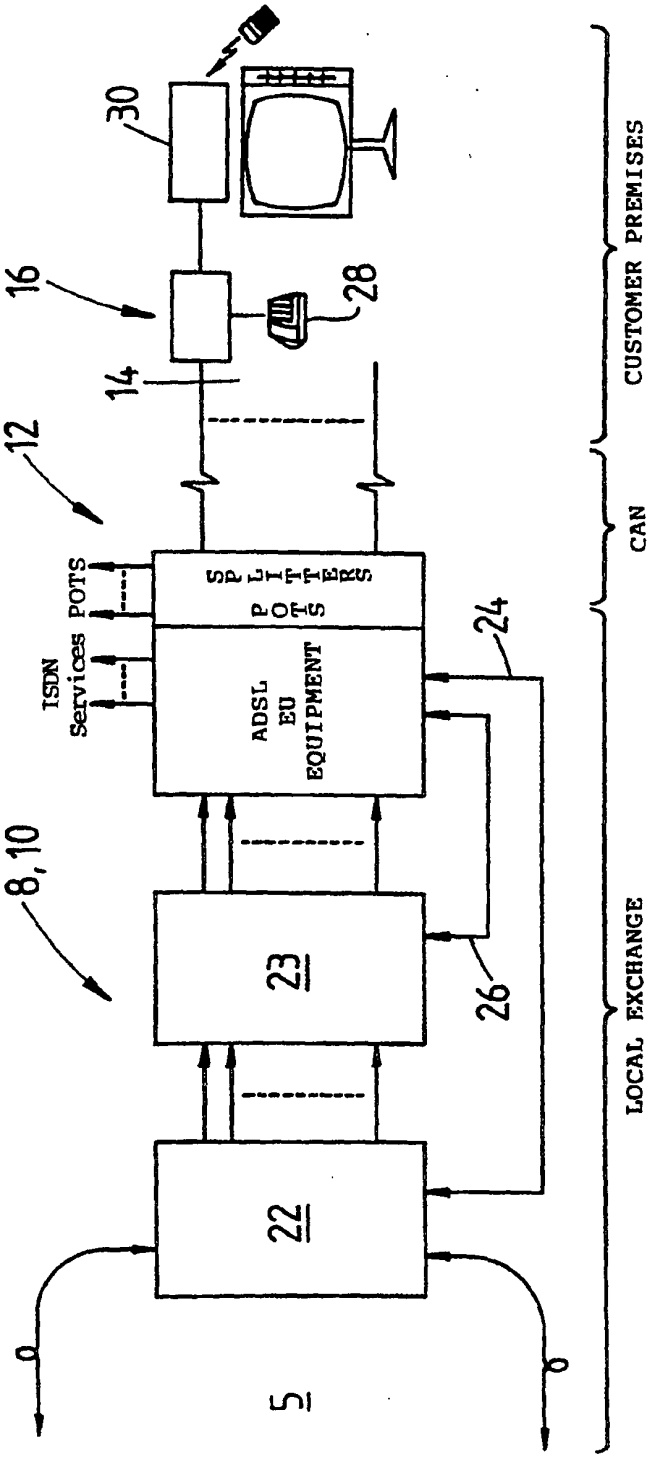
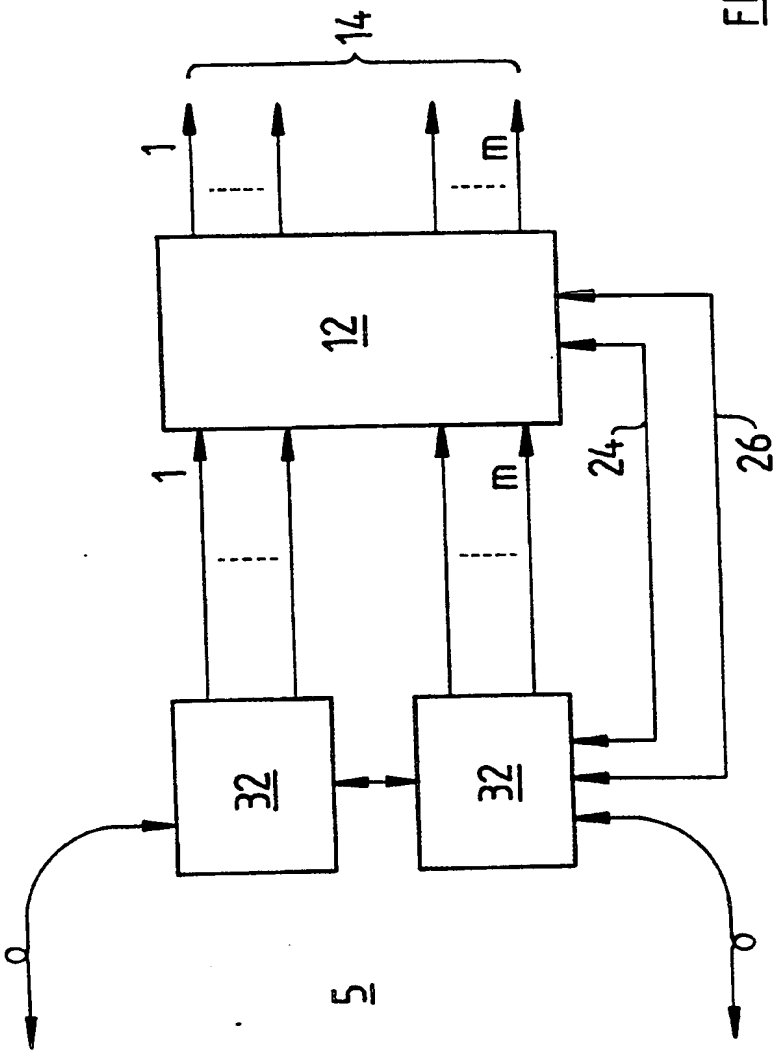

30
16
28
14
12
SPLITTERS
POTS
POTS
ISDN
Services
ADSL
EU
EQUIPMENT
24
8,10
23
26
22
5
CUSTOMER PREMISES
CAN
LOCAL EXCHANGE

FIG 2

FIG 3



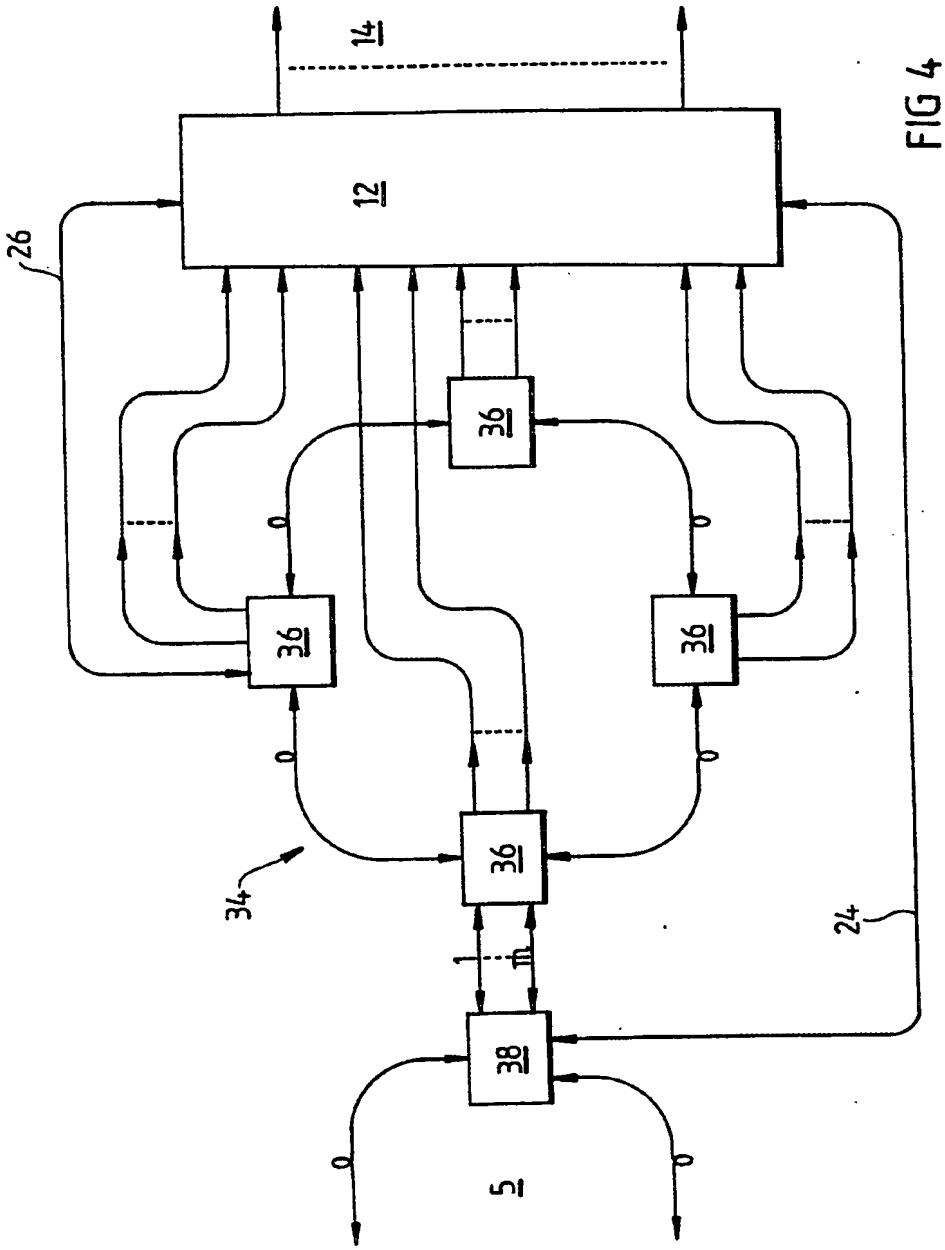


FIG 4

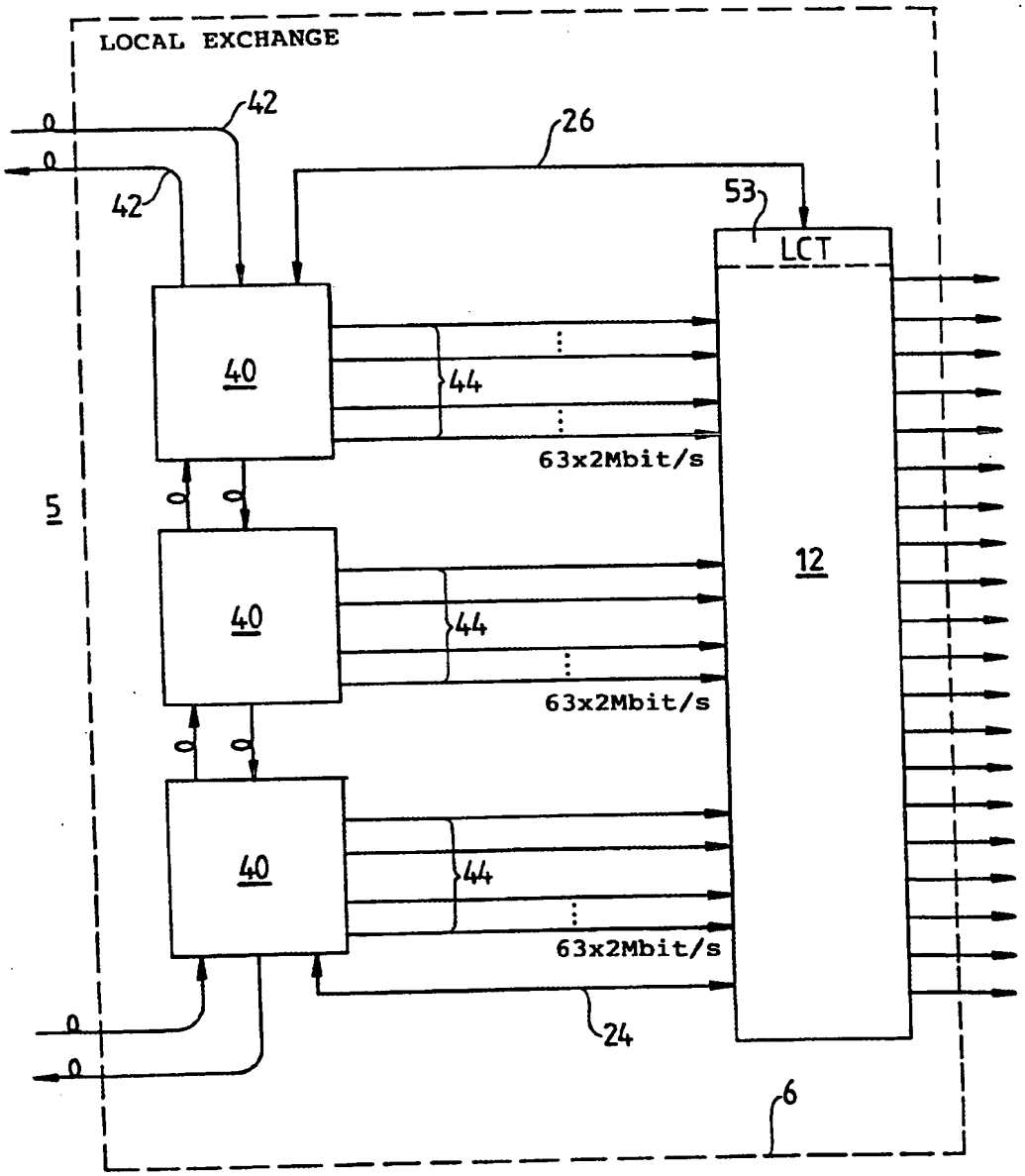

LOCAL EXCHANGE
42
42
26
53
LCT
40
44
63x2Mbit/s
40
44
63x2Mbit/s
40
44
63x2Mbit/s
5
12
24
6

FIG 5

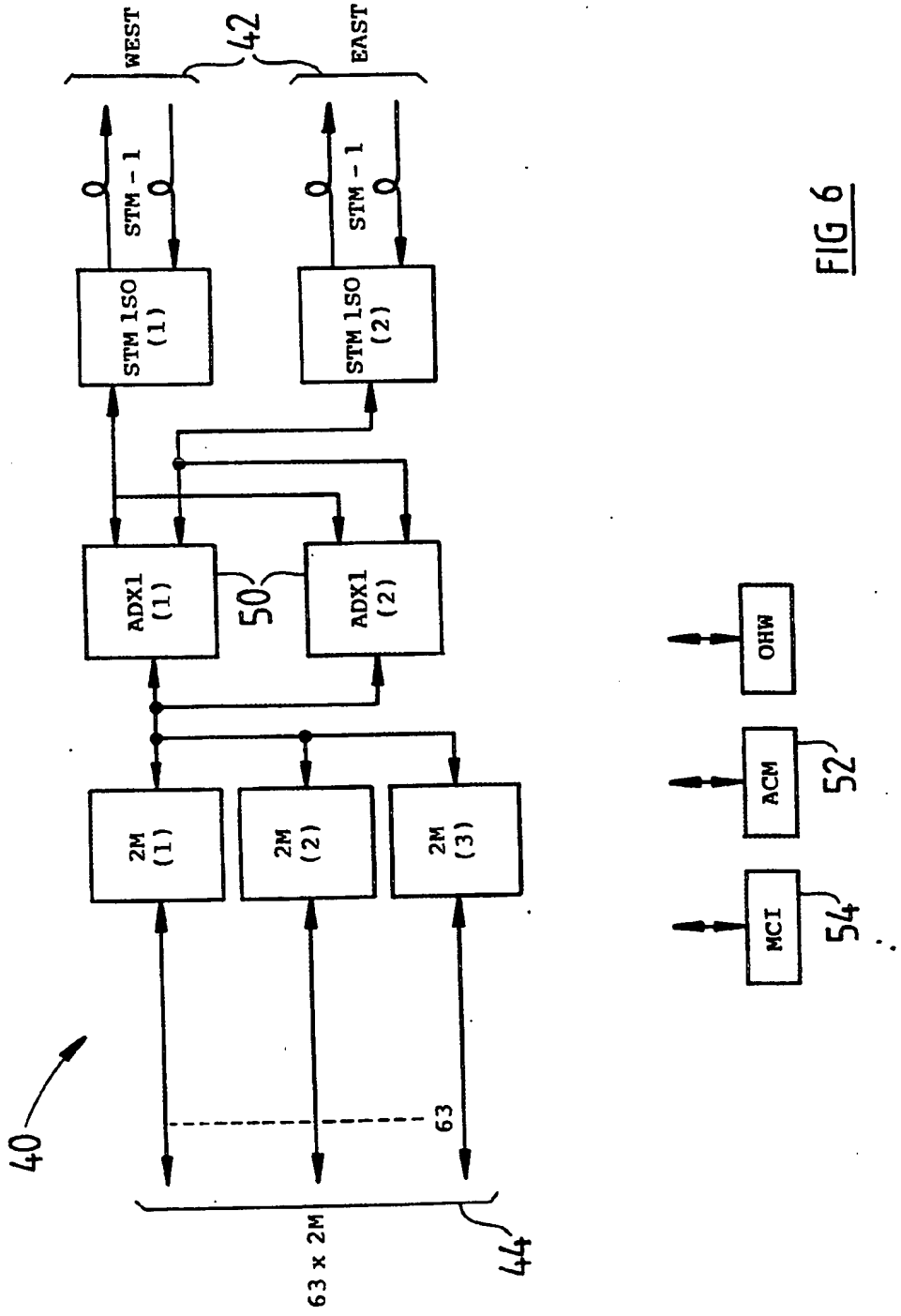

WEST
42
EAST
STM - 1
STM - 1
STM 1SO (1)
STM 1SO (2)
ADX1 (1)
50
ADX1 (2)
OHW
ACM
52
MCI
54
2M (1)
2M (2)
2M (3)
63
40
63 x 2M
44

FIG 6

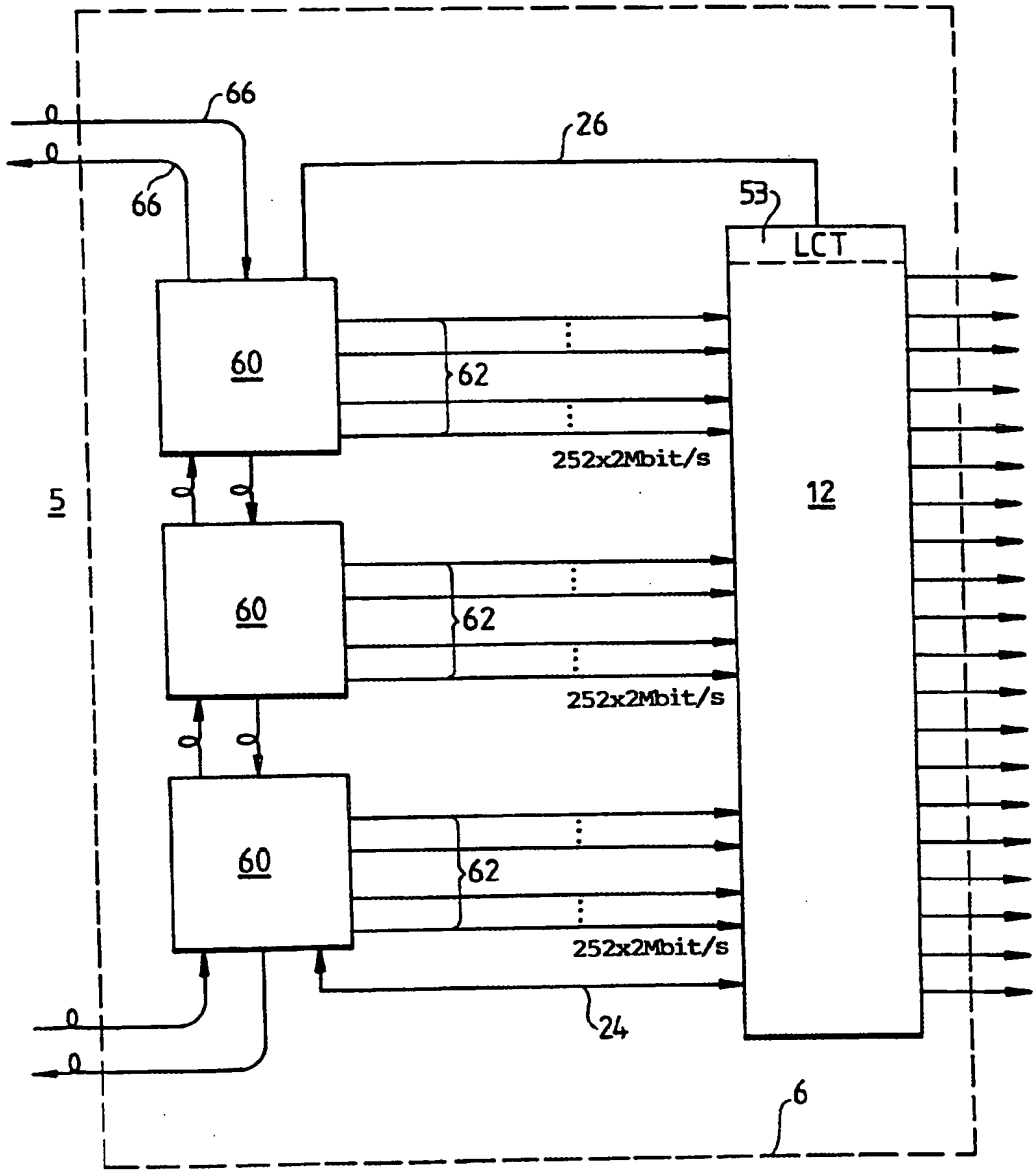

66
66
26
53
LCT
60
62
252x2Mbit/s
12
5
60
62
252x2Mbit/s
60
62
252x2Mbit/s
24
6

FIG 7

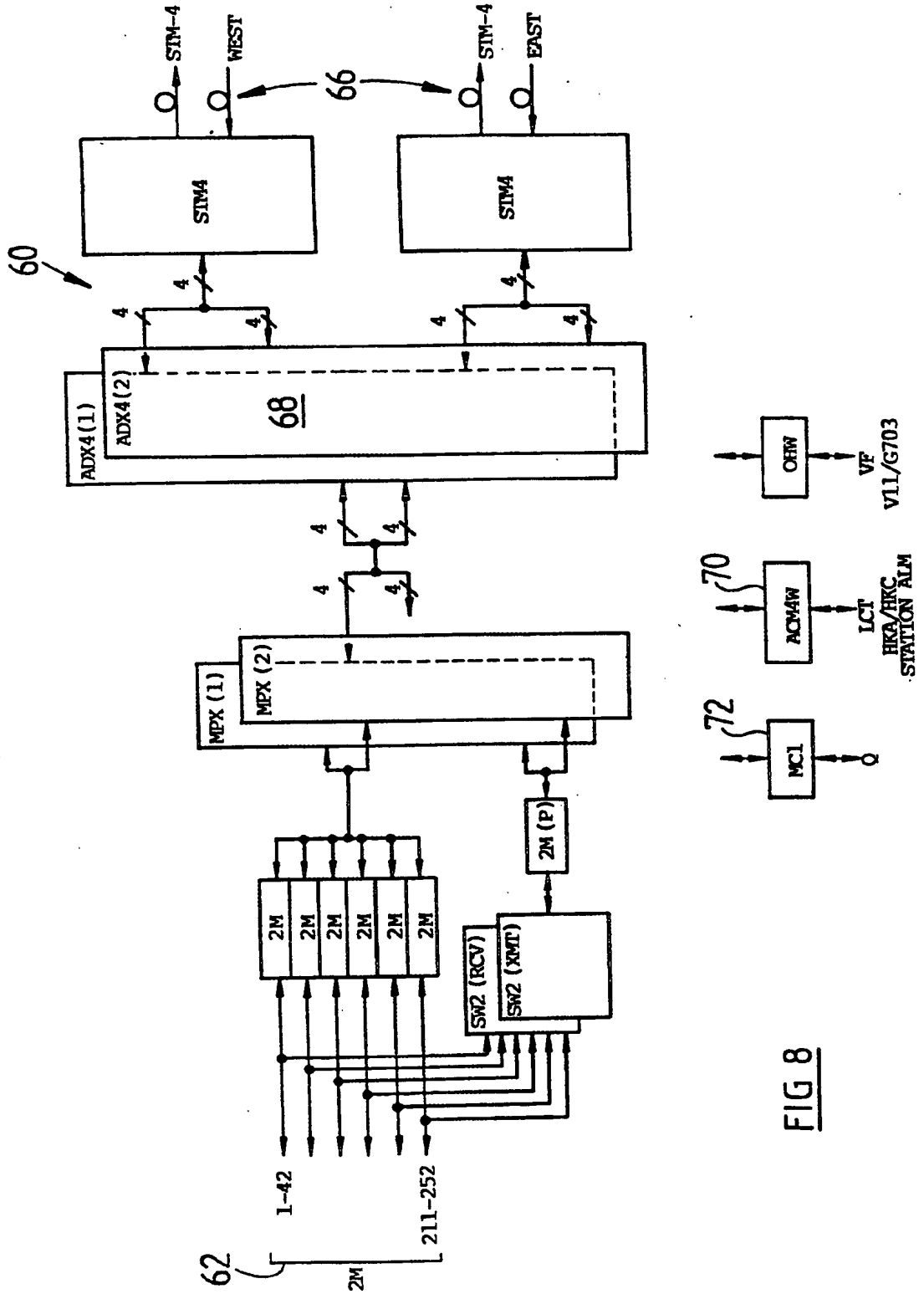

STM-4
WEST
STM-4
EAST
66
STM4
STM4
60
4
ADX4(1)
ADX4(2)
68
MPX (1)
MPX (2)
2M (P)
2M
SW2 (RCV)
SW2 (XMT)
1-42
211-252
62
2M
OHW
VF
V11/G703
70
ACM4W
LCT
HKA/HKC
STATION ALM
72
MC1

FIG 8

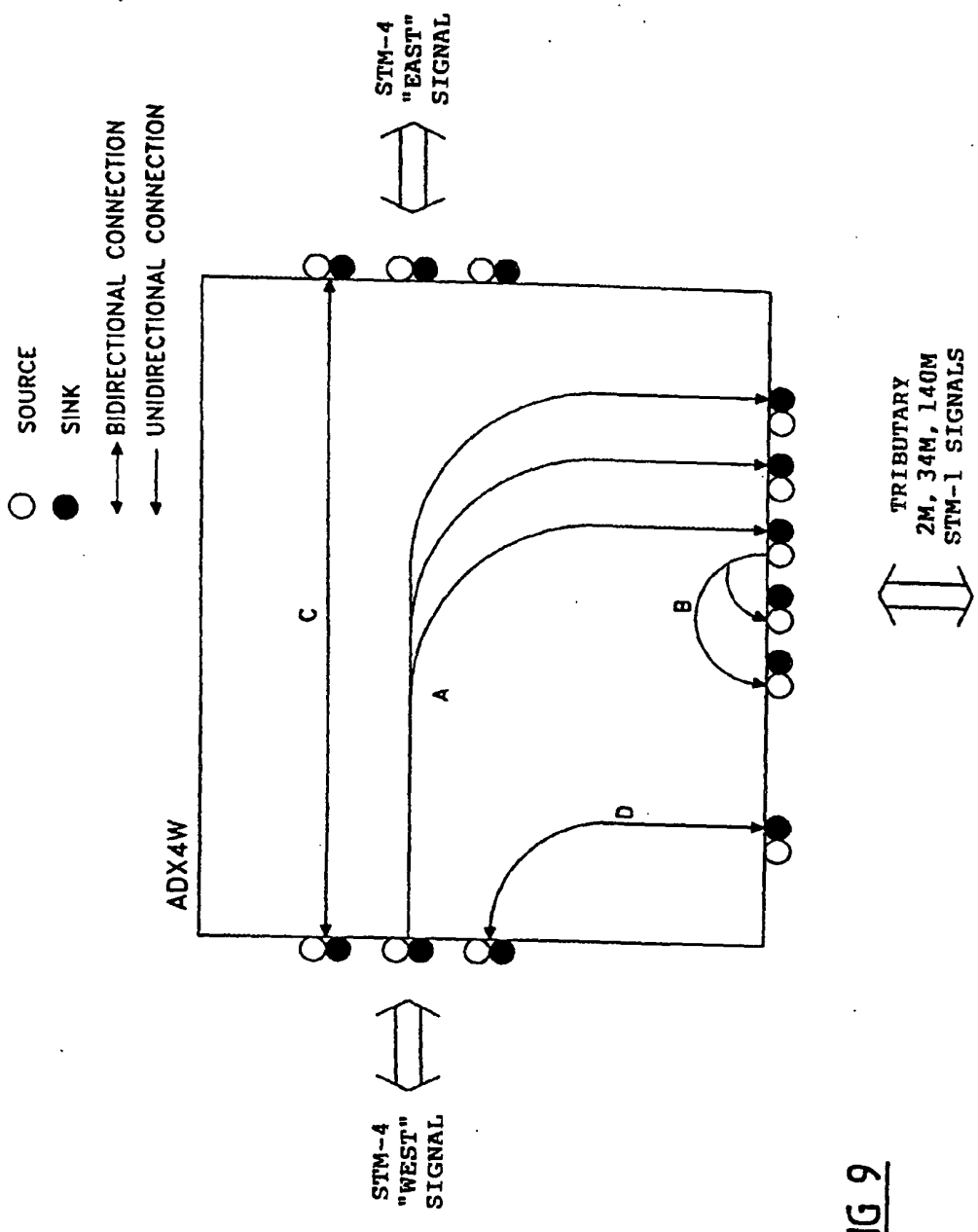

STM-4 "EAST" SIGNAL
SOURCE
SINK
BIDIRECTIONAL CONNECTION
UNIDIRECTIONAL CONNECTION
TRIBUTARY 2M, 34M, 140M STM-1 SIGNALS
ADX4W
A
B
C
D
STM-4 "WEST" SIGNAL

FIG 9

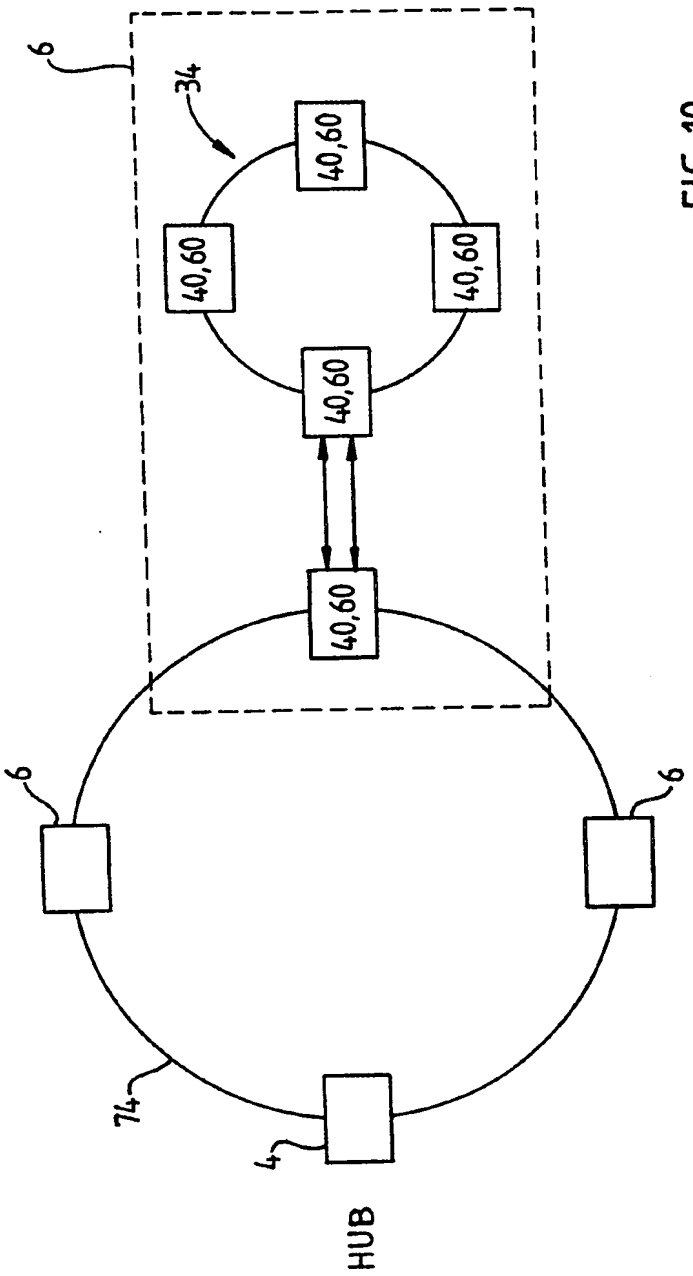


FIG 10

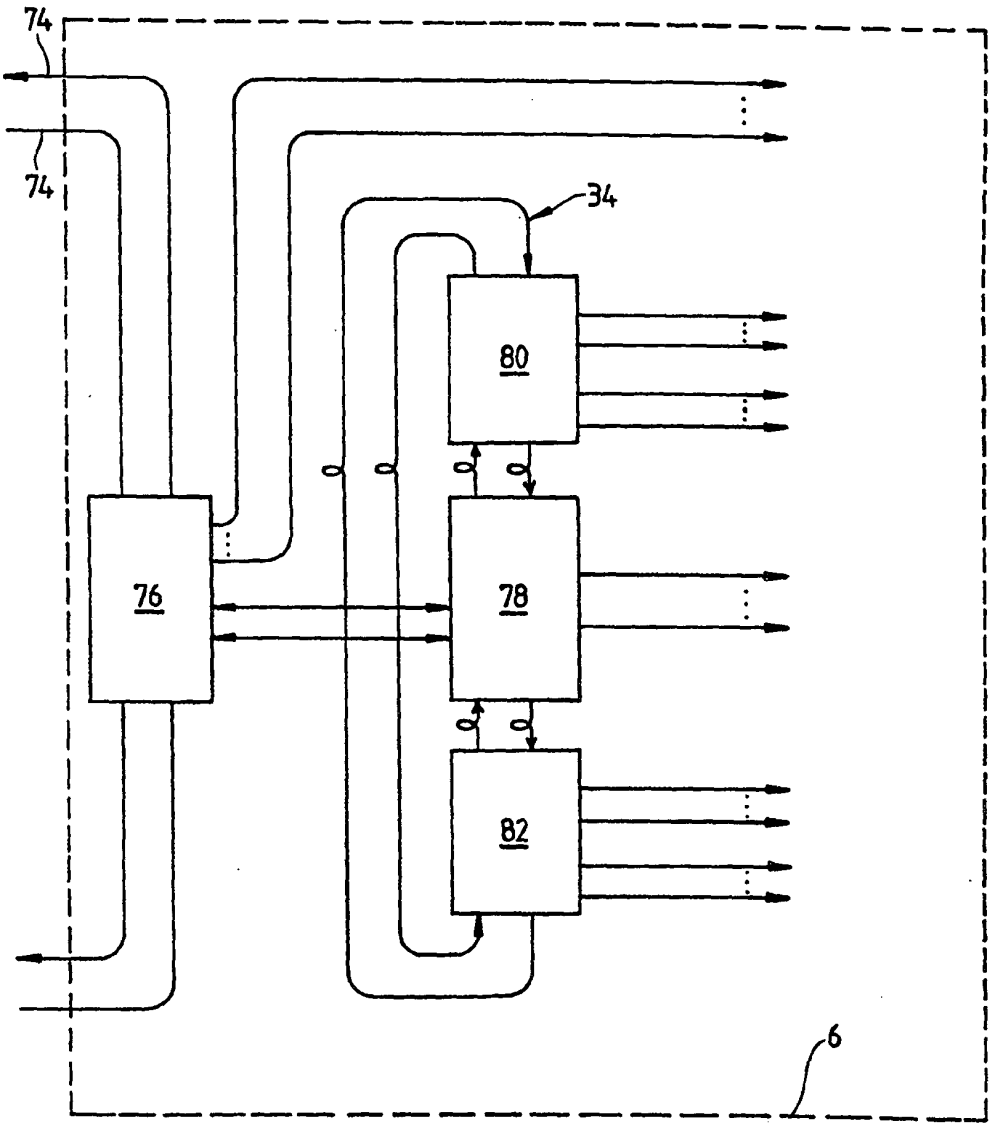


FIG 11

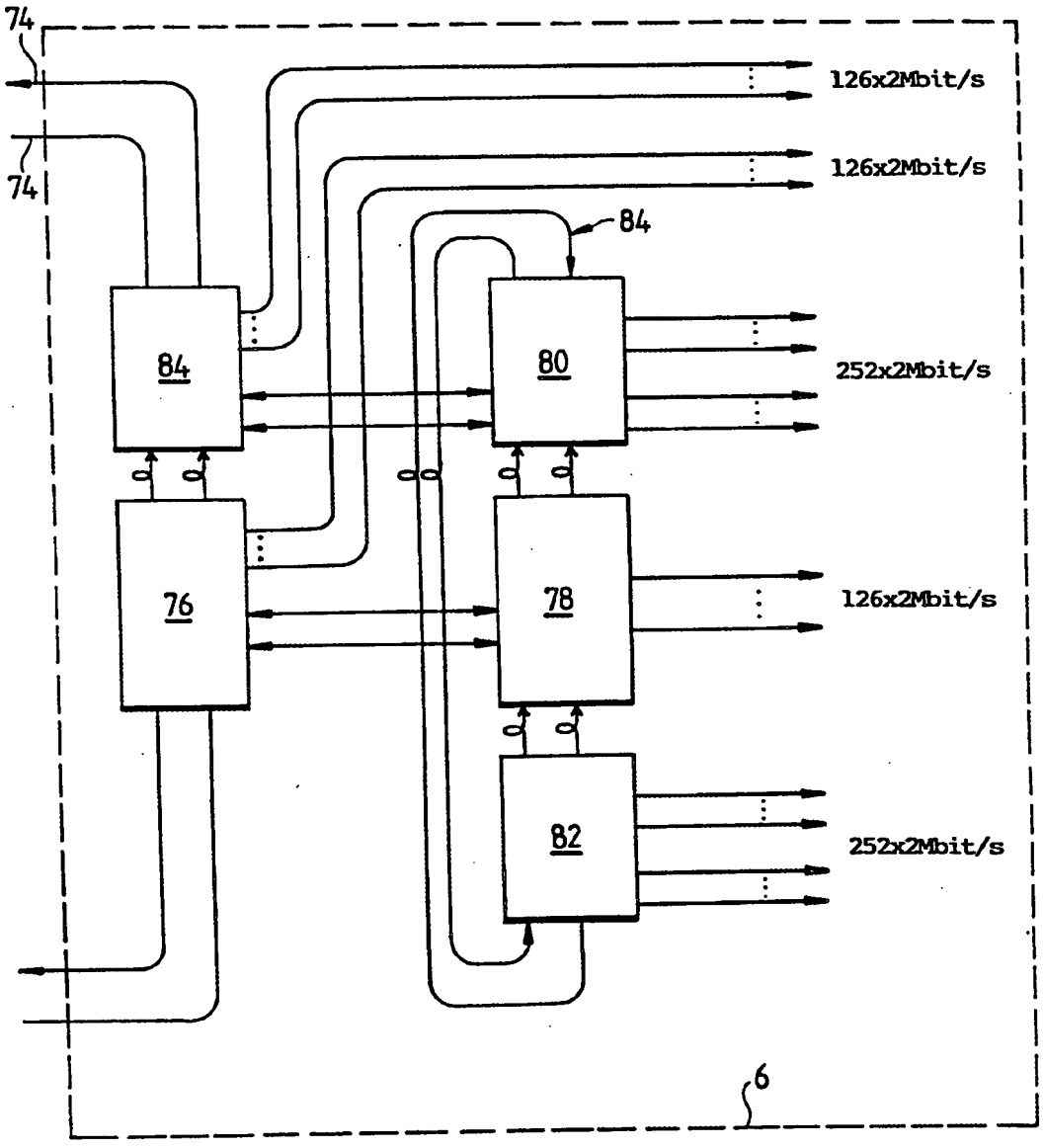

74
74
126x2Mbit/s
126x2Mbit/s
84
84
80
252x2Mbit/s
76
78
126x2Mbit/s
82
252x2Mbit/s
6

FIG 12

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 96/00560

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: H04N 7/173, H04H 1/04, 1/08

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC H04N 7/173, 7/17, H04H 1/04, 1/08, H04L 12/16, 12/18, 11/18, H04M 11/08, 3/42

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DERWENT: SWITCH or DISTRIBUTION
JAPIO : SWITCH or DISTRIBUTION

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Proceedings IEEE INFOCOM '90, Conference on Computer Communications, ninth annual joint conference of the IEEE Computer and Communications Societies, Los Alamitos, IEEE Computer Society Press, 1990. T.S. YUM, "Hierarchical Distribution of Video with Dynamic Port Allocation", pages 321-328 Page 321, column 2, lines 12-39, Fig. 1.	1, 6, 7
X	IEEE Transaction on Networking, Vol. 2, No. 6, December 1994 IEEE Computer Society, New York, NY. Y.W. Leung et al., "A Modular Multirate Video distribution System - Design and Dimensioning", pages 549-557 Pages 549-552. Figs. 1-8 Pages 555, column 2 - page 556, column 1, Fig. 9.	1, 6, 7

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 November 1996	9 DEC 1996
Name and mailing address of the ISA/AU AUSTRALIAN INDUSTRIAL PROPERTY ORGANISATION PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (06) 285 3929	Authorized officer J. LAW Telephone No.: (06) 283 2179

Form PCT/ISA/210 (second sheet) (July 1992) copjhw

INTERNATIONAL SEARCH REPORT

...ernational Application No.
PCT/AU 96/00560

C (C ntinuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	AU 61924/94 A (ALCATEL N.V.) 24 November 1994 Page 8 line 24 - page 11 line 19, Fig. 1	1, 6, 7
X	Patent Abstract of Japan, E839, page 34, JP 1-190150 A (NIPPON TELEPH CORP) 31 July 1989 Abstract	1
P,X	WO 95/34169 A (UNISYS CORPORATION) 14 December 1995 The Abstract, pages 11-17, Fig. 1	1-7

INTERNATIONAL SEARCH REPORT
Information on patent family members

International Application No.
PCT/AU 96/00560

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
AU	61924	AU	670189	EP	625855	NZ	260222
WO	9534169						

END OF ANNEX